CLAIMS

I claim:

1. An aluminum-containing material deposition method comprising:

depositing a first precursor on a substrate in the substantial absence of a second precursor, the first precursor exhibiting gas phase reactivity with the second precursor, the first precursor comprising a chelate of $Al(NR^1R^2)_x(NR^3(CH_2)_zNR^4R^5)_y$ or $Al(NR^1R^2)_x(NR^3(CH_2)_zOR^4)_y$; where x is 0, 1, or 2; y is 3 - x; z is an integer from 2 to 8; and $R_1$ to $R_5$ are independently selected from among hydrocarbyl groups comprising 1 to 10 carbon atoms with silicon optionally substituted for one or more carbon atoms; and

depositing the second precursor on the first deposited precursor in the substantial absence of a non-deposited first precursor, the second precursor comprising at least one of a nitrogen source and an oxidant, and a deposition product of the first and second precursors comprising at least one of an aluminum nitride or an aluminum oxide.

2. The method of claim 1 wherein the deposition method comprises atomic layer deposition and the first and second precursors are deposited as monolayers.

3. The method of claim 1 wherein the first precursor consists essentially of $Al(N(CH_3)_2)_2(N(CH_3)CH_2CH_2N(CH_3)_2)$.

4. The method of claim 1 wherein depositing the first precursor occurs at a temperature of from about 100 °C to about 450 °C.

5. An atomic layer deposition method comprising:

chemisorbing a first precursor on a substrate in the substantial absence of a second precursor, the first precursor exhibiting gas phase reactivity with the second precursor, the first precursor comprising a chelate of $Al(NR^1R^2)_x(NR^3(CH_2)_zNR^4R^5)_y$ or $Al(NR^1R^2)_x(NR^3(CH_2)_zOR^4)_y$; where x is 0, 1, or 2; y is 3 - x; z is an integer from 2 to 8; and $R_1$ to $R_5$ are independently selected from among hydrocarbyl groups comprising 1 to 10 carbon atoms with silicon optionally substituted for one or more carbon atoms; and

reacting the second precursor with the first chemisorbed precursor, the second precursor comprising at least one of a nitrogen source and an oxidant, and a reaction product of the first and second precursors comprising at least one of an aluminum nitride or an aluminum oxide.

6. The method of claim 5 wherein the hydrocarbyl groups are selected from among alkyl, alkenyl, cycloalkyl, cycloalkenyl, or aryl with silicon optionally substituted for one or more carbon atoms.

7. The method of claim 5 wherein the first precursor is a liquid at a temperature of from about 20 °C to about 100 °C.

8. The method of claim 5 wherein the first precursor is vaporized at a temperature of from about 25 °C to about 150 °C.

9. The method of claim 5 wherein the first precursor exhibits a vapor pressure of at least about 0.1 Torr at a temperature of from about 25 °C to about 150 °C.

10. The method of claim 5 wherein the first precursor exhibits a chemisorption rate of at least about 0.5 monolayers per second at $10^{-4}$ Torr with a solid surface comprising an oxide having hydroxyl groups on the oxide surface, platinum, rhodium, iridium, titanium, TiN, TaN, TaSiN, TiBN, or silicon.

11. The method of claim 5 wherein the first precursor is non-pyrophoric.

12. The method of claim 5 wherein the first precursor comprises a single species and is optionally mixed with a non-reactive carrier gas.

13. The method of claim 5 wherein the chemisorbed first precursor forms a monolayer.

14. The method of claim 5 wherein the substrate comprises at least one of an oxide material and a metal element.

15. The method of claim 5 wherein the substrate comprises at least one of metal oxide, platinum, titanium, and TiN.

16. The method of claim 5 wherein chemisorbing the first precursor occurs at a temperature of from about 100 °C to about 450 °C.

17. The method of claim 5 wherein z is an integer from 2 to 4.

18. The method of claim 5 wherein $R_1$ to $R_5$ are independently selected from among hydrocarbyl groups comprising 1 to 5 carbon atoms with silicon optionally substituted for one or more carbon atoms.

19. The method of claim 5 wherein the second precursor comprises at least one of $O_2$, $O_3$, $H_2O$, ammonia, hydrazine, alkyl-hydrazine compounds, and other hydrazine derivatives.

20. The method of claim 5 wherein chemisorbing the second precursor occurs at substantially the same temperature as chemisorbing the first precursor.

21. The method of claim 5 wherein the chemisorption product comprises AlN or $Al_2O_3$.

22. An atomic layer deposition method comprising:

chemisorbing a first precursor on a substrate at a temperature of from about 150 °C to about 250 °C in the substantial absence of a second precursor, the first precursor exhibiting gas phase reactivity with the second precursor, the first precursor comprising a chelate of $Al(NR^1R^2)_x(NR^3(CH_2)_zNR^4R^5)_y$ or $Al(NR^1R^2)_x(NR^3(CH_2)_zOR^4)_y$; where x is 0, 1, or 2; y is 3 - x; z is an integer from 2 to 4; and $R_1$ to $R_5$ are independently selected from among hydrocarbyl groups comprising 1 to 5 carbon atoms with silicon optionally substituted for one or more carbon atoms; and

reacting the second precursor with the first chemisorbed precursor at substantially the same temperature, the second precursor comprising at least one of a nitrogen source and an oxidant, and a reaction product of the first and second precursors comprising at least one of AlN or $Al_2O_3$.

23. The method of claim 22 wherein the first precursor is a liquid at a temperature of from about 20 °C to about 100 °C.

24. The method of claim 22 wherein the first precursor is vaporized at a temperature of from about 25 °C to about 150 °C.

25. The method of claim 22 wherein the first precursor exhibits a vapor pressure of at least about 0.1 Torr at a temperature of from about 25 °C to about 150 °C.

26. The method of claim 22 wherein the first precursor exhibits a chemisorption rate of at least about 0.5 monolayers per second at $10^{-4}$ Torr with a solid surface comprising an oxide having hydroxyl groups on the oxide surface, platinum, rhodium, iridium, titanium, TiN, TaN, TaSiN, TiBN, or silicon.

27. The method of claim 22 wherein the first precursor is non-pyrophoric.

28. The method of claim 22 wherein the first precursor comprises a single species and is optionally mixed with a non-reactive carrier gas.

29. An atomic layer deposition method comprising:

chemisorbing a monolayer of a first precursor on a substrate at a temperature of from about 100 °C to about 400 °C in the substantial absence of a second precursor, the first precursor consisting essentially of $Al(N(CH_3)_2)_2(N(CH_3)CH_2CH_2N(CH_3)_2)$ and the substrate comprising at least one of metal oxide, platinum, titanium, and TiN;

purging the first precursor from the over the substrate;

reacting a monolayer of the second precursor with the first chemisorbed precursor, the second precursor comprising at least one of a nitrogen source and an oxidant, and a reaction product of the first and second precursors comprising at least one of AlN or $Al_2O_3$;

purging the second precursor from the over the substrate; and

successively repeating exposure and purging of the first and second precursors to form a capacitor dielectric layer.